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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/711,456	09/20/2004	Jeffrey P. Gambino	BUR920040162US1	5455
30449	7590	05/30/2006	EXAMINER	
SCHMEISER, OLSEN & WATTS			LE, DUNG ANH	
22 CENTURY HILL DRIVE				
SUITE 302			ART UNIT	PAPER NUMBER
LATHAM, NY 12110			2818	

DATE MAILED: 05/30/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/711,456

Applicant(s)

GAMBINO ET AL.

Examiner

DUNG A. LE

Art Unit

2818

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-60 is/are pending in the application.
- 4a) Of the above claim(s) 22-60 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-21 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 20 September 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_.

- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_.

*DETAILED ACTION*

**Oath/Declaration**

The oath/declaration filed on 9/20/2004 is acceptable.

**Election/Restriction**

Applicant's election **with traverse of Species I: claims 1-21** is acknowledged.

Applicant's election with traverse of **Species I, claims 1-21: Method for manufacturing an interconnect having steps forming a first capping layer on said top surface of said wire and said top surface of said dielectric, said first capping layer thin enough to allow penetration of said first capping layer by appoint of a conductive probe tip in order to make electrical contact to said wire; and form a second capping layer on a top surface of said first capping layer** is acknowledged.

Because Applicant did not distinctly and specifically point out the supposed error in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)). Applicant have the right to file a divisional application covering the subject matter of the non-elected claims *Species II, e.g. claims 22- 38: Method for manufacturing a structure having steps forming a first capping layer on said top surface of said wire and said top surface of said dielectric, after that performing one or more characterization procedures in relation to said structure; Species III, e.g. claims 50- 54: Method for manufacturing an interconnect having steps storing said substrate in a controlled environment and perform further processing steps on said substrate and Species IV, e.g. claims 55- 60: Method for manufacturing an interconnect having steps if said period of time exceeds a predetermined period of time, performing a rework clean or a*

*rework chemical mechanical polishing and after that performing further processing steps on said substrate.*

The traversal is on the ground(s) that see the election paper. This is not found persuasive because the fields of search for *Species I*, *Species II*, *Species III* -*Species VI* claims are NOT coextensive and the determinations of patentability of *Species I*, *Species II*, *Species III* -*Species VI* are different, that is *Species I*, *Species II*, *Species III* -*Species VI* limitations are given weight differently in determining the patentability of the claimed inventions. Also, the strategies for doing text searching of *Species I*, *Species II*, *Species III* -*Species VI* claims are different. Thus, separate searches are required. The requirement is still deemed proper and is therefore made **FINAL**.

### ***Information Disclosure Statement***

This office acknowledges of the following items from the Applicant:

Information Disclosure Statement (IDS) filed on 9/20/2004 and 1/25/2005 have been considered and made of record. The references cited on the PTOL 1449 form have been considered.

### ***Specification***

The specification has been checked to the extent necessary to determine the presence of all possible minor errors. However, the applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

**Claim Rejections**

***Claim Rejections - 35 USC § 112***

Claims 1, 3 and 7 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 1, the limitation “---first capping layer thin enough---“ is vague and indefinite. It is not clear which thin is desired.

In claims 3 and 7, the limitation “---first capping layer sufficiently thick---“ is vague and indefinite. It is not clear which thick is desired.

The remaining claims are dependent from the above rejected claims and therefore also considered indefinite.

***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty

defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

**Claims 1-3, 5-13, 15-18 and 20 are rejected under 35 USC 102 (e) as being anticipated by Lin et al. (2005/0242430 A1).**

Lin et al. teach a method of manufacturing an interconnect, comprising: (a) providing a substrate 10; (b) forming a dielectric layer 14 on said substrate; (c) forming a wire 18C/18D in said dielectric layer, a top surface of said wire coplanar with a top surface of said dielectric layer (figs 1A- 1E and related texts ); (d) forming a first capping layer 22 on said top surface of said wire and said top surface of said dielectric layer, said first capping layer thin enough ( SiN, 50 A- 500A) in paragraph [0021] to allow penetration of said first capping layer by a point of a conductive probe tip in order to make electrical contact to said wire 18C/18D; and (e) after step (d) forming a second capping layer 24 on a top surface of said first capping layer.

**Regarding claim 2**, wherein said wire includes copper exposed to an ambient atmosphere at said top surface of said wire (fig. 1C and related texts).

**Regarding claim 3**, wherein said first capping layer 22 (eg. SiN, 50 Å- 500Å) is sufficiently thick to prevent formation, on said top surface of said wire, of copper containing particles by reaction of said wire with said dielectric layer [0021].

**Regarding claim 6**, wherein said wire includes copper 18C/18D exposed to an ambient atmosphere at said top surface of said wire (fig.1C and related texts).

**Regarding claim 7**, wherein said first capping layer is sufficiently thick (eg. SiN, 50 Å- 500Å) to prevent formation, on said top surface of said wire, of copper containing particles by reaction of copper in said wire with fluorine in said dielectric layer.

**Regarding claim 8**, wherein said first capping layer 22 and said second capping layer 24 independently include a material selected from the group consisting of  $\text{Si}_{x_1}\text{N}_{y_1}$ ,  $\text{Si}_{x_2}\text{C}_{y_2}$ ,  $\text{SiC}_{x_3}\text{H}_{y_3}$ ,  $\text{SiC}_{x_4}\text{O}_{y_4}\text{N}_{z_4}$  and  $\text{SiC}_{x_5}\text{N}_{y_5}$ . (Fig. 1E and related texts , [0025]).

**Regarding claim 9**, wherein said first capping layer and said second capping layer independently include one or more layer of materials selected

from the group consisting of Si.sub.xN.sub.y, Si.sub.xC.sub.y, SiC.sub.xH.sub.y, SiC.sub.xO.sub.yN.sub.z and SiC.sub.xN.sub.y. (Fig. 1E and related texts , [0025]).

**Regarding claim 10**, wherein said first capping layer 22 has a thickness between about 100 .ANG. and 300 .ANG. (Page 4, claim 14).

**Regarding claim 11**, wherein said second capping layer has a thickness between about 150 .ANG. and 700 .ANG. (Page 4, claim 15).

**Regarding claim 12**, wherein said second capping layer is a copper diffusion barrier [0004].

**Regarding claim 13**, wherein said first capping layer 22 in combination with said second capping layer 24 is a copper diffusion barrier [0004].

**Regarding claim 15**, wherein forming said first capping layer 22 comprises forming silicon nitride by high density plasma deposition and forming said second



capping layer 24 comprises forming silicon nitride formed by plasma enhanced chemical vapor deposition [0023].

**Regarding claim 16**, further including between steps (d) and (e), cleaning said top surface of said first capping layer [0022].

**Regarding claim 17**, further including between steps (d) and (e), cryogenically (100-400 C) cleaning said top surface of said first capping layer [0023].

**Regarding claim 18**, further including between steps (c) and (d), cleaning (by CMP [0020]) said top surface of said wire and said top surface of said dielectric layer in a reducing environment.

**Regarding claim 20**, first capping layer (silicon nitride is transparent material) is thin enough (Page 4, claim 14, eg., 10- 500 Å) to be transparent to visible light, to back-scattered electrons in a SEM or to both.

**Claim Rejections - 35 USC § 103**

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

**Claim 14 is rejected under 35 U.S.C. 103 (a) as being unpatentable over Lin et al. in view of Chen et al. (2004/0187304 A1).**

Lin et al. teaches the claimed invention as applied to claim 1 except for forming another dielectric layer on a top surface of said second capping layer, said second capping layer acting as a reactive ion etch stop for etching said another dielectric layer.

Chen teaches the step of forming another dielectric layer on a top surface of said second capping layer 360, said second capping layer acting as a reactive ion etch stop for etching said another dielectric layer ([0053] and fig. 3E and related texts) .

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to form another dielectric layer on a top surface of said second capping layer, said second capping layer acting as a reactive ion etch stop

for etching said another dielectric layer in Lin 's method in order to form overlaying upper level metal interconnect.

**Claims 4, 19 and 21 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Lin et al. in view of the following remark.**

**Regarding claim 4,** Lin et al. teaches the claimed invention as applied to claim 1 except for dielectric layer comprises fluorinated silicon glass and wherein said dielectric layer comprises about 1% to about 9% by weight of fluorine as cited in current claim.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize dielectric layer comprises fluorinated silicon glass, because it is commonly used to prevent undesirable or detrimental reactions in process of making a conductive interconnection structure.

It would have been obvious to one having ordinary skill in the art at the time of the invention was made to utilize dielectric layer comprises fluorinated silicon glass to create interconnect structure wherein dielectric layer comprises about 1% to about 9% by weight of fluorine, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art.

**Regarding claim 19**, Lin et al. teaches the claimed invention as applied to claim 1 except for further including between steps (d) and (e), performing one or more characterization procedures selected from the group consisting of optical or SEM inspection and optical or SEM image size measurement.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to perform one or more characterization procedures selected from the group consisting of optical or SEM inspection and optical or SEM image size measurement between steps (d) and (e), because it is commonly used to inspect multi level interconnect structure without damaging contact region, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended application.

**Regarding claim 21**, Lin et al. teaches the claimed invention as applied to claim 1 except for second capping layer is formed at a temperature of about 350C or greater as cited in current claim.

However, it would have been obvious to one having ordinary skill in the art making semiconductor device to determine the workable or optimal range for second capping layer is formed at a temperature of about 350C. or greater through routine experimentation and optimization to optimal device performance.

When responding to the office action, Applicants' are advice to provide the examiner with the line numbers and page numbers in the application and/or references cited to assist the examiner to locate the appropriate paragraphs.

A shortened statutory period for response to this action is set to expire 3 (three) months and 0 (zero) day from the day of this letter. Failure to respond within the period for response will cause the application to become abandoned (see M.P.E.P 710.02(b)).

### **Conclusion**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dung A. Le whose telephone number is (571) 272-1784. The examiner can normally be reached on Monday-Tuesday and Thursday 6:00am- 4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Nelms can be reached on (571) 272-1787. The central fax phone numbers for the organization where this application or proceeding is assigned are (571)272-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you

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have questions on access to the Private PAIR system, contact the Electronic Business

Center (EBC) at 866-217-9197 (toll-free).

DUNG A. LE  
Primary Examiner  
Art Unit 2818

A handwritten signature in black ink, appearing to read 'Dle', is positioned to the right of the typed name 'DUNG A. LE'.